Treatment of Perchlorate in Water

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Perchlorate Treatment Systems are Operating

- Full-scale perchlorate treatment systems are commercially-available and operating, although treatment costs and operational issues may be significant

- Technologies in use include ion exchange and biological treatment

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Progress Since 1997

- In 1997, little was known about perchlorate treatment
- Since 1997, many bench-scale and pilot-scale studies have been completed
- In 2002, full-scale systems are commercially-available and operating in California and elsewhere

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Relevant Properties of Perchlorate - The Bad News

- Not volatile
  => Not removed by air stripping
- Highly soluble
  => Not strongly adsorbed by GAC
- Stable in typical ground and surface waters
  => Not readily chemically-reduced
  => Does not readily biodegrade

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Relevant Properties - The Good News

- Perchlorate is strongly retained by some synthetic resins
- Will biodegrade in an anoxic environment

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Ion Exchange

- Removes undesirable ion(s) from water
- Undesirable ion replaced by chemically-similar but less toxic or nontoxic ion (e.g., Na^{+} replaces Ca^{++})
- Ion exchange medium may be naturally-occurring mineral or synthetic resin

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Ion Exchange - Advantages

- Effective
- Commercially-available
- Familiar technology

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Ion Exchange - Disadvantages

- Does not destroy the contaminant
- Produces a concentrated waste brine requiring further treatment or disposal
- Moderate to high cost

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Full-Scale Ion Exchange Systems Operating in CA and NV

- 2,500 gpm system operated by La Puente Valley County Water District (Los Angeles County)

- Full-scale system at Kerr-McGee facility (Henderson, NV)

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La Puente Valley County Water District system

- Capacity: 2,500 gpm
- Use of Treated Water: drinking water supply
- Resin Regeneration: onsite
- Operational: 2000 to present
- Vendor: Calgon Carbon Corp
- Part of San Gabriel Valley/ Baldwin Park Superfund Site (1st phase of 26,000 gpm in treatment capacity)

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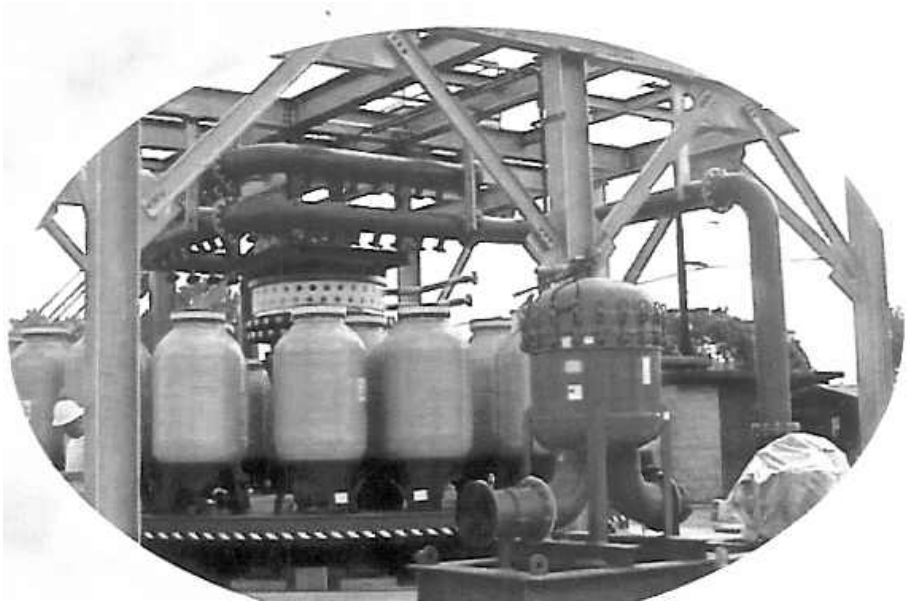

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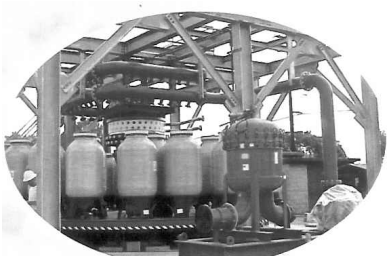
La Puente Valley County Water District System - Cost and Performance

- Perchlorate Influent: approx. 100 ug/L
- Perchlorate in Treated water: < 4 ug/L
- Capital Cost: approx. $2 million
- Operating Cost: approx. $145/acre-foot



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Brine Disposal/ Treatment

- At La Puente facility, waste brine discharged to dedicated brine disposal line
- Leading candidates for brine treatment are a high-temperature catalytic unit and anoxic biological treatment

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Biological Treatment

- Microbes can chemically reduce undesirable chemical to less toxic or non-toxic chemicals
- Microbes of interest may require changes in physical/chemical environment to thrive (e.g., anoxic conditions, added nutrients)

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Biological Treatment - Advantages

- Effective
- May be destructive technology (i.e., no waste brine produced)
- Potentially less expensive than ion exchange

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Biological Treatment - Disadvantages

- Less familiar technology - regulatory and community acceptance may be significant issues
- Requires post-reactor treatment to produce potable water

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Full-Scale Biological Reactors Operating in California and Utah

- 3,600 gpm system operated by Aerojet-General Corporation (Northern CA)
- Continuously stirred tank reactors (CSTR) at Thiokol facility (Utah)

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Aerojet-General Bioreactor System

- Bioreactor Type: fixed film on GAC operated as fluidized bed
- Total Capacity: 3,600 gpm
- End Products: primarily chloride and oxygen
- Use of Treated Water: aquifer recharge
- Carbon Source/Electron Donor: Denatured ethanol
- Operational: 1998 to present
- Vendor: Envirogen Inc.
- Part of Aerojet Superfund Site

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Aerojet-General Bioreactor System - Cost and Performance

- Perchlorate Influent: approx. 2,500 ug/L
- Perchlorate in Treated water: < 4 ug/L
- Capital Cost: approx. $5.5 million
- Reported Operating Cost: approx. $65/acre-foot

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Other Technologies

- Reverse Osmosis/Nanofiltration
- Biologically Active Carbon (BAC)
- Abiotic Reduction Using Ozone/GAC
- Chemical/Electrochemical Reduction

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Sources of Perchlorate Treatment Technology Information

- May 2000 GWRTAC Technology Summary at: *www.frtr.gov/perchlorate*
- American Water Works Association Research Foundation at: *http://www.awwarf.com/research/spperch.asp*
- Vendors

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